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Coral Diversity of Hengam Island, Persian Gulf, Iran

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ABSTRACT

Coral reef ecosystems play an important role in the cycle of life in the Persian Gulf. It is difficult to monitor and manage coral ecosystem due to a lack of baseline data on the coral diversity in the Persian Gulf. This study investigated the diversity of corals in the Hengam Island, Persian Gulf, south of Iran. Reef communities were surveyed at 3 sites namely Tiny wall, Acropora and Dive Persia, with 3 randomly 200 × 1 m randomly belts transects (parallel to the shore) at a depth of 2-6 m and at least10m gap between neighbor transects at different stations, using Line Intercept Transect (LIT) and Manta Tow Technique (MTT) methods. Corals were identified to the genus level *in situ* and to the species level by underwater photography where possible using available new reference texts. A total of 17 scleractinian coral species, representing 13 genera and 7 families, were recorded at near-shore coral reefs Hengam Island. Out of this number, 2, 6 and 8 species were falls under vulnerable, nearly threatened and Least Concern categories, respectively. Furthermore, only one species were identified to the genus level. This study would make the Hengam Islands one of the richest areas for coral species in the Persian Gulf for areas of a similar size. So, the best management strategies to conserve these productive habitats are required.
KEYWORDS: Iran, Coral Reef, Diversity, Hengam Island, Persian Gulf, Iran.

INTRODUCTION

Every day, corals, reef structures, and the coral reef ecosystems play an important role in the cycle of life (Goodwin, 2006).Coral reefs are of great importance for remarkable biodiversity; coastal protection; providing seafood and new medicines; and recreational value in Persian Gulf (Bauman, 2013). They are also extremely sensitive to small environmental perturbations over the short-term (Rezai et al., 2004). Slight changes in one component of the ecosystem may have detrimental effects on the health of entire coral colonies (Aubrecht et al., 2008).

It has recently been estimated that coral reefs occupy 284,300 sq. km. of the planet's surface (Goodwin, 2006).Because of the widespread distribution of coral reefs and their occurrence in remote locations, the most practical approach to the global survey of reef stressors and the monitoring of conditions that affect reefs is through the use of remotely sensed data (Riegl, et al., 2012a).According to Foster *et al.*, (2011), natural and anthropogenic disturbances including cyclones, climatic change, bleaching, disease outbreaks and removal of grazers have greatly influenced coral reefs and caused changes to their community structure. Global warming has also caused in the frequency and severity of the corals' bleaching phenomenon (Goldberg and Wilkinson, 2004). Until 2002, because of high temperature, almost all types of branching corals were completely destroyed in the north of Persian Gulf (Rezai et al., 2010).

There are however several studies concerning the diversity of coral reefs (Kavousi et al., 2011; Madani et al., 2013; Samiei et al., 2013; Shojae et al., 2011) and their threats (Riegl et al., 2012b; SamimiNamin et al., 2010; Shahhosseiny et al., 2013)in the Persian Gulf. Little published information exists about Hengam (Salarzadeh et al., 2013; Shahhosseiny et al., 2013) and such a coral community has not yet been reported in this island (Rezai et al., 2004).

In recent years, there has been an increasing interest in Hengam ecotourism (Nodehi&Omidvar, 2015). It is considered that the importance of Hengam island properties must be recognized and the protection of this island from threats must be enhanced. The focus of this paper is to determine a baseline data for the assessment of habitat and the status of the coral species in Hengam Island near-shore limits as the most important ecotourism properties in this island. This study therefore seeks to fulfil a number of aims. Principally, a complete species inventory of coral will be compiled. Finally, the status of the coral reefs and coral communities will be undertaken. These will provide

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information for identifying current and potential threats, which would lead to designation of areas needing specific protection and conservation management measures.

MATERIALS AND METHODS

Study area

This study was conducted at near-shore coral reefs Hengam Island. This island with only 33.6 ha area, is located in the south of Qeshm Island, near the Strait of Hormuz at the boundary of Persian Gulf and Oman Sea, within quadrant of 26˚ 36´ – 26˚ 41´ N and 55˚ 51´– 55˚ 55´ E (Fig. 1).

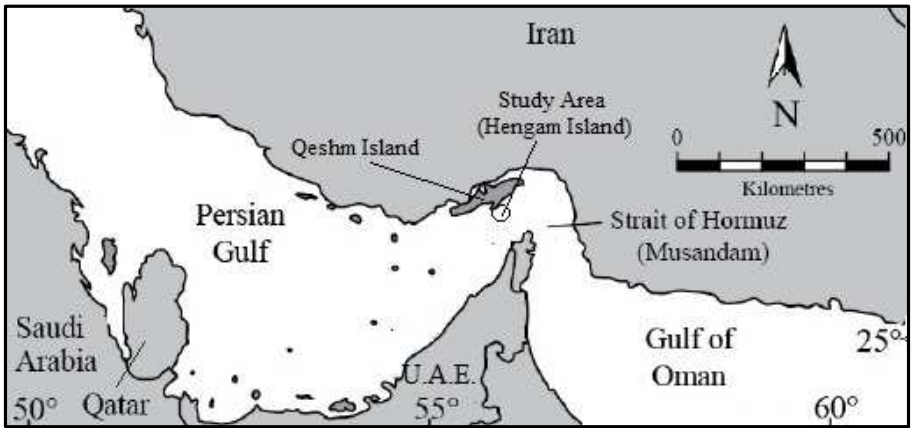


Fig. 1 Location of Study Area in Persian Gulf

The annual mean, minimum, and maximum temperatures were 27˚C, 13.3˚C and 39.2˚C in a 30-year period (1980–2010), respectively. The mean annual rainfall is about 173.1 mm that mainly occurs in winter. The mean monthly relative humidity is 66.4% (Table1). Maximum depth reached was 7 m in low tides and with increasing depth, hard substrate decrease and extent of sand and muddy beds increase. Regional water salinity is reported 33-44 psu. Preliminary studies indicate that sparse or dense corals are found around the island, as well as in the north.

Table1 Climatic parameters in Hengam Island (2000-2010)

Parameter	Average	Max (Month)	Min (Month)
Sunshine hours (hr)	9.1	11 (June)	7.4 (December)
Temperature (C°)	27	39.2 (August)	13.3 (January)
Wind (m/s)	1.4	Note: Prevailing wind from southwest	
Relative humidity (%)	66.4	87.2 (February)	39.9 (June)
Rainfall(mm)	173.1	46.5 (January)	0.0 (June-July)
Evaporation (mm)	1967.8	255.9 (August)	32.1 (January)

Study design

This study was performed from November 2011 to August 2012.

Reef communities were surveyed at 3 sites namely Tiny wall, Acropora and Dive Persia (Fig. 2), using Line Intercept Transect (LIT) and Manta Tow Technique (MTT) methods described in the Methods for Ecological Monitoring of Coral Reefs (Hill & Wilkinson, 2004).A diver equipped with snorkel and fins was towed around the island over the depths of 2-6 m, with a speed of 3-5 km per hour, equivalent to a slow walk for two minutes, at an approximate distance of 200-250 m from the shore (Moran et al., 1989).

Fig. 2 Position of Study sites in Hengam Island

At each site, surveys were conducted on three randomly200 × 1 m belts transects (parallel to the shore) at a depth of 2-6 m. There was at least10m gap between neighbor transects at different stations as described by Aghajan-Pouret al. (2013).

Corals were identified to the genus level *in situ* and to the species level by underwater photographywhere possible using available new reference texts (Erhardt& Knop, 2005; Spalding *et al.*, 2001; Wilson *et al.*, 2003; Wood & Scheer, 1983).

Corals were photo-graphed using a Nikons V underwater camera with a 20 mm lens and twin Ikelite 50 strobes, and an Olympus C3030 digital camera in an Olympus underwater housing attached to a single Ikelite 50 strobe. Close-up photos were taken with a Nikons V using a two to one framer and 35 mm lens.

Furthermore, conservation status and population trend of identified corals were generated by IUCN Red List of Threatened Species (version 3.1), 2012, 2.

RESULTS

For a period of one year of sampling, started from September 21th 2008, a total of 16 scleractinian coral species, representing 13 genera and 7 families, were identified to the species level and one species was identified to the genus level, either insitu or from collected specimens and underwater photographs. Table 2 gives classification of corals according to species and family in Hengam. Out of this number, 2 species including *Psammocora stellata*[1] and *Pavona decussate*, were falls under Vulnerable(V) category, 6 species (about 17%) including *Acropora arabensis, Favites micropentagona*, *Platygyra acuta*, *Porites lobata* and *Stylophora pistillata* were falls under Nearly Threatened (NT) whereas 8 species (about 2.7%) considered as Least Concern (LC) category. Furthermore, nine species considered as native species in Persian Gulf limited.

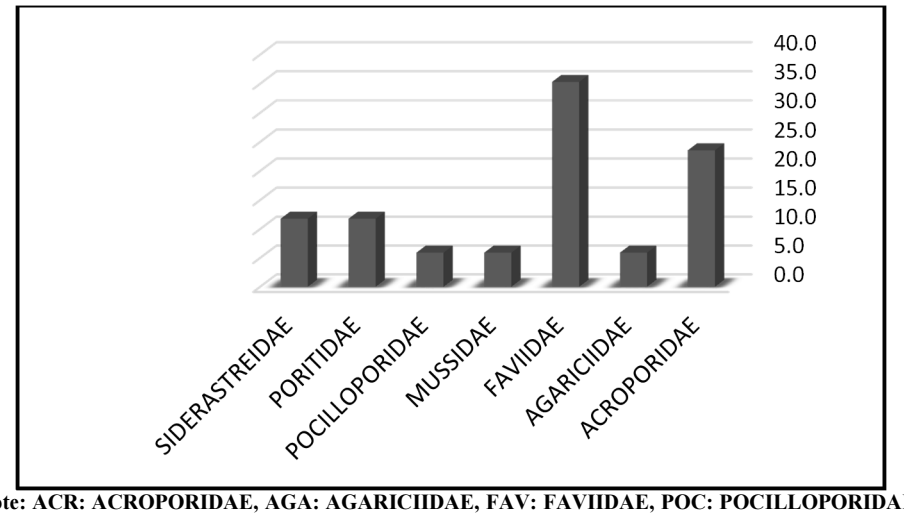
Faviidae (35.3%) and Acroporidae (23.5%) are the most diverse corals family in near-shore of Hengam Island (Fig.3). Moreover, all genus of Acropora, Favia, Montipora, and Psammocora with 2 species were the most abundant genus in the study area. Fig 4 gives the photos of observed hard corals in Hengam.

[1]Synonym/s: *Psammocora brighami* Vaughan 1907

Table 2 List of hard corals[2] recorded at Hengam Island offshore, IRAN

Scientific Name	Species Authority	Family	Pop. trend	Status
Acanthastrea echinata	Dana, 1846	MUSSIDAE	Unknown	LC
Acropora arabensis	Hodgson & Carpenter, 1995	ACROPORIDAE	Decreasing	NT, N
Acropora downingi	Wallace, 1999	ACROPORIDAE	Decreasing	LC
Cyphastrea microphthalma	Lamarck, 1816	FAVIIDAE	Decreasing	LC, N
Echinopora hirsutissima	Milne Edwards and Haime, 1849	FAVIIDAE	Decreasing	LC
Favia sp.	-	FAVIIDAE	-	-
Favia speciosa	Dana, 1846	FAVIIDAE	Decreasing	LC, N
Favites micropentagona	Veron, 2002	FAVIIDAE	Decreasing	NT, N
Goniopora columna	Dana, 1846	PORITIDAE	Unknown	NT, N
Montipora aequituberculata	Bernard, 1897	ACROPORIDAE	Unknown	LC, N
Montipora danae	Milne Edwards and Haime, 1851	ACROPORIDAE	Decreasing	LC
Pavona decussata	Dana, 1846	AGARICIIDAE	Unknown	VU, N
Platygyra acuta	Veron, 2002	FAVIIDAE	Decreasing	NT
Porites lobata	Dana, 1846	PORITIDAE	Unknown	NT, N
Psammocora profundacella	Gardiner, 1898	SIDERASTREIDAE	Unknown	LC, N
Psammocora stellata	Verrill, 1868	SIDERASTREIDAE	Unknown	VU
Stylophora pistillata[3]	Esper, 1797	POCILLOPORIDAE	Unknown	NT, N

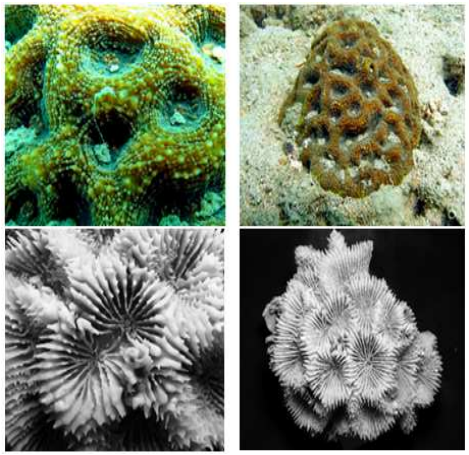
Note: NT: Near Threatened, VU: Vulnerable, LC: Least Concern, N: Native in Persian Gulf



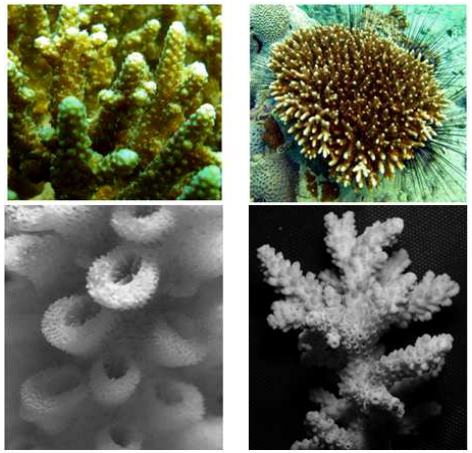
Note: ACR: ACROPORIDAE, AGA: AGARICIIDAE, FAV: FAVIIDAE, POC: POCILLOPORIDAE, POR: PORITIDAE, SID: SIDERASTREIDAE

Fig. 3 Distribution percentage of coral families in Hengam Island, IRAN

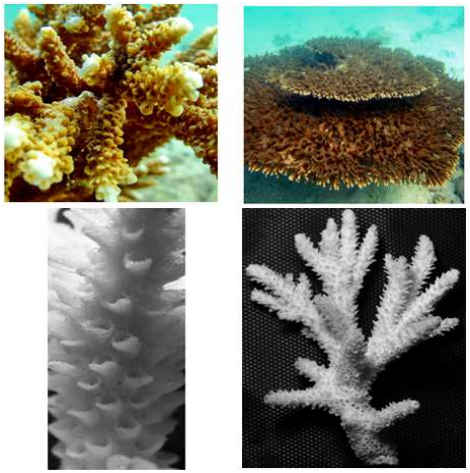
[2] Phylum: CNIDARIA, Class: ANTHOZOA, Order: SCLERACTINIA
[3]Common English Name/s: Smooth Cauliflower Coral



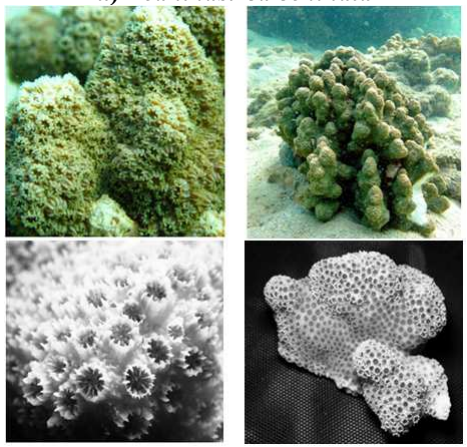
a) ***Acanthastrea echinata***



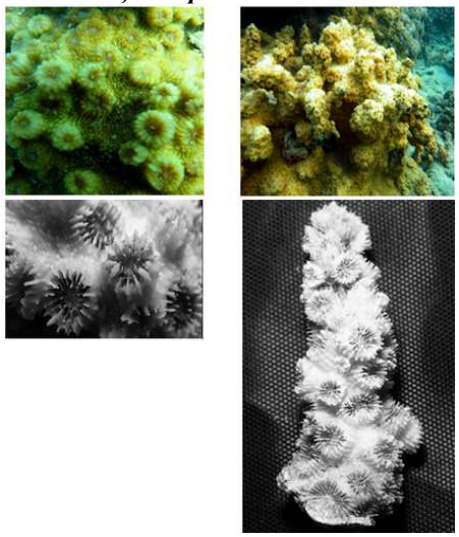
b) ***Acropora arabensis***



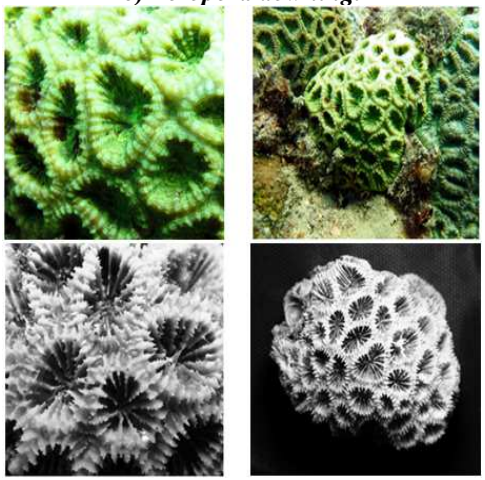
c) ***Acropora downingi***



d) ***Cyphastrea microphthalma***

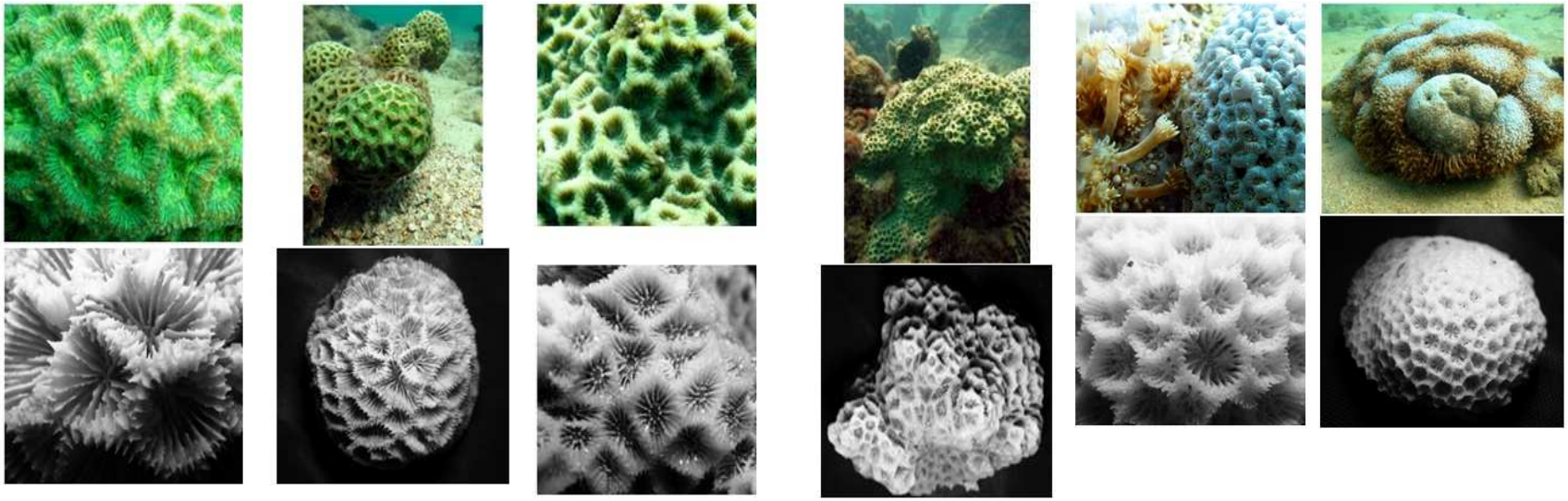


e) ***Echinopora hirsutissima***

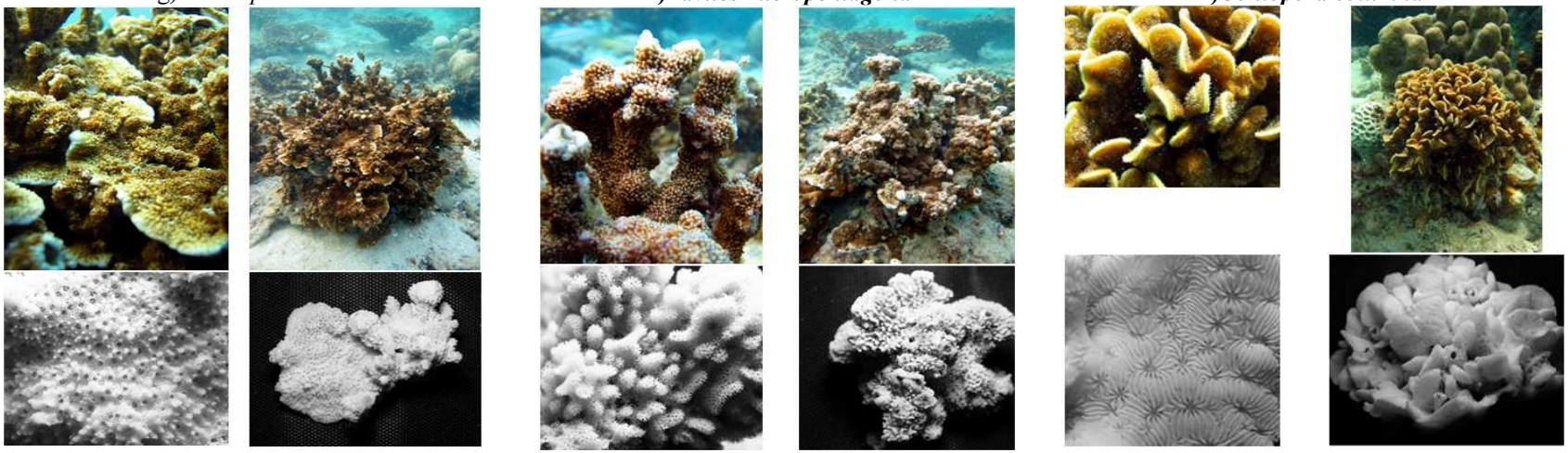


f) Favia sp.

Fig.4 Photos of observed corals in Hengam Island, including species view (top, right), species close-up view (top, left), bleached species photograph (down, right), and bleached species close-up view (down, left)



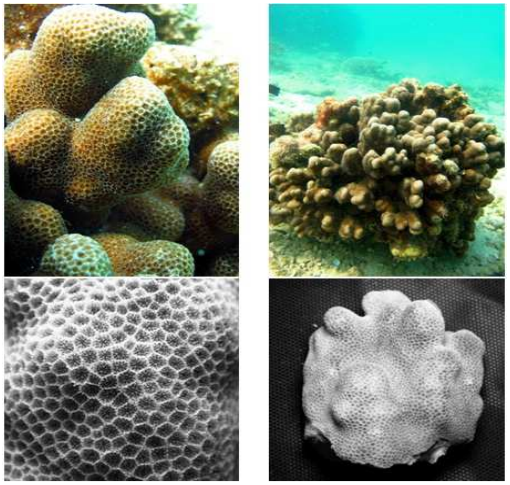
g)*Favia speciosa* **h)*Favites micropentagona*** **i)*Goniopora columna***



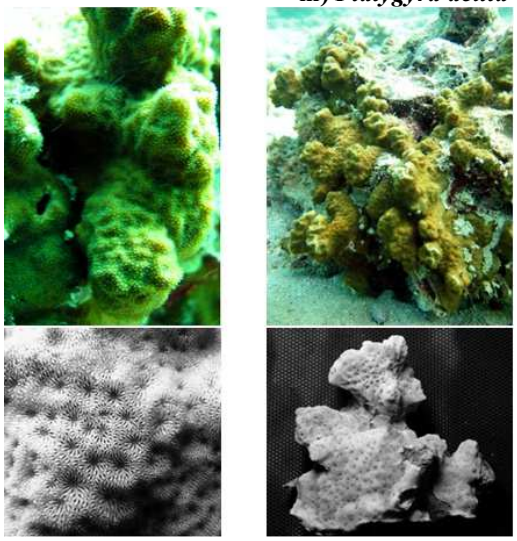
j)*Montipora aequituberculata* **k)*Montipora danae*** **l)*Pavona decussate***

Fig.4 cont. Photos of observed corals in Hengam Island, including species view (top, right), species close-up view (top, left), bleached species photograph (down, right), and bleached species close-up view (down, left)

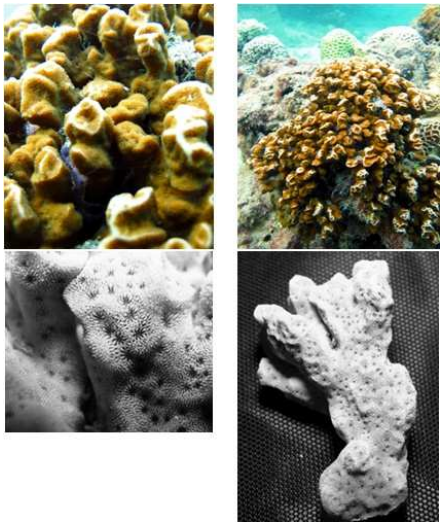
m) *Platygyra acuta*



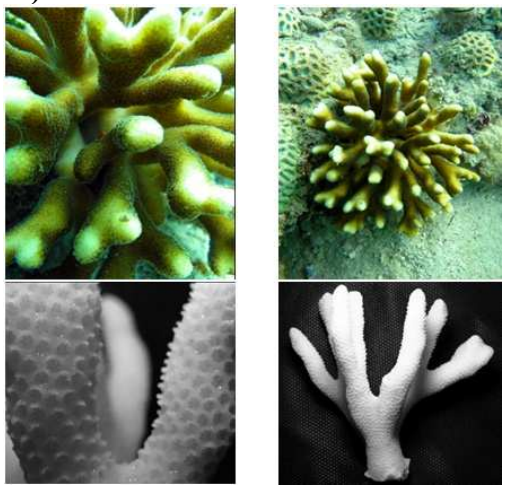
n) *Porites lobata*



o) *Psammocora profundacella*



p) *Psammocora stellata*



q) *Stylophora pistillata*

Fig.4 cont. Photos of observed corals in Hengam Island, including species view (top, right), species close-up view (top, left), bleached species photograph (down, right), and bleached species close-up view (down, left)

DISCUSSION

The live hard corals are considered as the most important coral-reef composition and an indicator of coral health (Rezai et al., 2010).The main objective of this study was establishing a baseline data for the assessment of habitat and the status of the coral species in Hengam Island near-shore limits.

A total of 17 hard coral species, representing 13 genera and 7 families were recorded in the study sites. It means that according to the area, Hengam is interest in terms of coral species diversity and composition, habitat diversity and uniqueness. Moreover, photos taken during study indicated that reefs in Hengam Island are of great natural beauty and biological richness. It may be possible toconsider the reefs of Hengam as a reference to Persian Gulf reefs.

Diversity of hard corals observed in Hengam, however, could not compare with 359 individual species of hard corals in the Great Barrier Reef located in the Indo-Pacific (DeVantier et al., 2006), or with a global maximum of about 450 species in Indonesian and Philippine waters, while according to the area, is higher than those in nearby Kish (Madani et al., 2013), Qeshm (Kavousi et al., 2011)and Larak (Shojae et al., 2011)islands in the north of Persian Gulf,as well as water off Kuwait (Carpenter, 1997), and UAE (Sheppard, 1988).

Most coral species in Hengam Island had a full geographic spread and the cluster analysis did not detect any strong geographic pattern in the distribution of sites.

Out of our objective, a large number of Sea urchins (Long-spined sea urchin *Diadema antillarum*from Diadematidae), Brittle sea star (Ophiotrichidae), Sea anemone and Sea cucumbers are visible in the study area, especially at Dive Persia. These animals have been suggested as an indicator of biological nutrients and a key-stone species throughout coastal area (Tuya et al., 2004). The high density of these invertebratesoccurs due to the high level of nutrients and thus shift a decline in coral cover (Aronson &Precht, 2000)and increasing RKC, however, the mortality spread at first slowly.Negatively effects of coral growth has been reported due to increasing the abundance of these invertebrates and having long-term effects on the physical structure of the reef(Ostrander et al., 2000). Macro-algae can rapidly colonize a substrate as long as herbivores such as *D. antillarum*, nutrient limitation, and physical factors do not inhibit them. Thus, corals cannot successfully colonize a substrate dominated by algae (Ostrander et al., 2000). Moreover, sponges and bivalves were observed that may compete with corals for space on the reef, or that may bio-erode the coral structure and therefore can damage or destroy coral colonies. As, the results of study showed that the percentage of Recently Killed Coral (RKC) in Tiny Wall, Dive Persia and were estimated 4, 3.75 and 0.75 %, respectively.

Long-spined sea urchin **Brittle sea star** **Sea anemone**

Fig. 5 Invasive organisms in the Hengam coral reef habitat

The importance of coral ecosystems as a factor in contributing towards maintaining wildlife population is well known, but our ability to predict the future behavior of complex environmental systems is quite limited. Thus, Management of coral area in Hengam include the following sections:

- Environmental Impact Assessments for any development in Hengam, is necessary.
- Efforts should be made to reduce negative impacts of island development in coral diversity, density and abundance.
- Management of coral area in Hengam depends upon an understanding of how many and which species can persist in different types of managed ecosystems.
- Awareness campaigns for user communities should be developed using local languages, religious leaders and cultural events. The end goal is to involve communities in direct management of coral ecosystems.
- At the academic level, governments would gain long-term economic advantages by enhancing and supporting a well-educated sector of marine environmental scientists and managers. This could take the form of financial support through scholarships or the establishment of new university departments focusing on the interdisciplinary nature of resource management (natural and physical sciences, economics, law, policy, etc.).

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